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PISTON DE-ACTIVATION MECHANISM FOR INTERNAL COMBUSTION ENGINES.

This invention relates to internal combustion engine mechanism for improving fuel economy during part load operation.

Conventional internal combustion engines (ICE) are generally configured in an in-line, horizontally opposed or in a V formation. In a vehicle installation they are sized in volumetric capacity to achieve the desired maximum speed and acceleration requirements. This engine size generally means that at low load conditions, deceleration and braking periods, which is majority of the time, the fuel consumption is high because the engine needs to be throttled.

Many attempts have been made to reduce the capacity of the engine during low load conditions by variable stroke mechanisms, and cutting off fuel to some of the cylinders, however, most have not been successful. In the case of shutting off fuel to some of the cylinders, this method has produced some improvements but because the pistons are still moving, thus creating friction, the maximum benefits have not been derived.

It is the object of this invention to present a means of completely de-activating and re-activating the pistons individually or in groups while the engine is in motion at a very fast rate as demanded by the vehicle via sensors and an engine management system.

The mechanism is presented by four drawings in which:

Figure 1 is a vertical cross section of one piston/crank assembly of a multi piston in-line or opposed engine in the active piston position.

Figure 2 is a horizontal cross section, Section A-A, of the engine in Fig. 1 through the output crank and main components of the mechanism.

Figure 3 is across section of the hydraulic switching mechanism.

Figure 4 is a vertical cross section of the piston crank assembly with the piston in the de-activated position.

It is to be understood that a complete engine must have at least two separate pistons in which one remains active at all times. The second or the balance of a multi-piston engine can have the pistons de-activated by the mechanism described below, and each piston can be deactivated separately as required. It is expected that such an engine will provide substantial fuel economy, particularly in city driving conditions.

Referring to Figs. 1 and 2, the engine mechanism 1 is housed in crank case 2. Piston assembly 4 moves in bore 6 and connects to the rocking member 8 via connecting rod 10 and forked link 12. Connecting rod 10 is rotatable on gudgeon pin 14 connected to the piston 4, and rotatably connected to forked link 12 via pin 16. The other end of the forked link 12 is rotatably connected to the rocking member 8 via pin 18.

Rocking member 8 has two trunnion pins 20 and 22 rotatable on respective bearings 24 and 26 mounted in the crank case 2. The rocking member 8 is connected to the crankshaft 28 via connecting rod 30 by pin 32 and crank pin 34. Thus piston 4 motion is transferred to the crankshaft 28 via connecting rod 10, forked link 12, rocking member 8 oscillating on trunnion pins 20 and 22, and connecting rod 30. The geometry of the linkage system is represented in Fig. 1 showing the piston 4 in approximately the mid stroke position with piston 4 stroke determined by the position of trunnion pins 20 and 22, pins 16 and 32, and

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the trow of crankpin 34. Pins 16 and 18 move trough an arc of a circle with the position of pin 32 determined by the desired position of the crankshaft 28.
The connection at pin 16 by connecting rod 10 and forked link 12 is held in position against a stop 36 fixed in rocking member 8, by the hydraulic cylinder and piston assembly 38, represented in more detail in Fig. 3, for clarity.

Cylinder and piston assembly 38 comprises of a cylinder 40 rotatably connected between the forked link 12 by trunnion pins 42 and 44. Piston and rod 46 move between two extremes determined by the geometry and position selected. The rod 46 is connected to a cross member 48 pivotable linked to rocking member 8 via pin ends 50 and 52. Cross member 48, and piston rod 46 allow hydraulic oil passages 54 and 56 to channel oil under pressure to either side of the hydraulic piston. Corresponding oil passages are machined in the rocking member 8 and on either side of the trunnion pins 20 and 22 (not shown), to an external hydraulic control system (not shown). These passages are sealed from the small angular movements of the trunnion pins 20 and 22 and pin ends 52 and 54, by a series of O-rings as depicted in Fig. 3.

Oil under pressure via passage 56 keeps the forked link in the position shown in Fig. 1 and the piston 4 is in the active position. In addition, the angled position of connecting rod 10, as it moves through the stroke ark, is such that when the piston 4 is in the top dead centre position (TDC), connecting rod 10 is toggled with forked link 12 and keeps the piston 4 against stop 36.

To de-activate piston 4 reference is made to Figure 3 and 4, in which oil under pressure is channelled via passage 54 (with passage 56 open to tank) pulling the connection at pin 16 fomed by forked link 12 and connecting rod 10 against stop 58 fixed to rocking member 8. This position of pin 16 in concentric with the trunnion pins 20 and 22 allowing rocking

member 8 to oscillate without imparting any motion to the piston 4. The fixed stroke piston and other parallel similar mechanisms of the engine (not shown) continuing the rotational motion of the crankshaft 28.

Oil under pressure via passage 56 will restore the position of pin 16 assembly against stop 36 to reactivate piston 4.

It is understood that upon any of the piston de-activation fuel is cut off to that cylinder and re-supplied upon activation.

In a four cylinder engine, for example, one cylinder contains a fixed stroke piston and three de-activateable (D-A) pistons. With the engine in the idle or with vehicle under deceleration and braking condition, only the fixed stroke piston need be active. During acceleration, each D-A piston can be activated in sequence to allow smooth introduction of power. During cruising conditions, only the number of pistons required, running at optimum efficiency need to be active. Under these operating condition considerable fuel savings will be achieved.

The scope of the invention need not be limited to the mechanism shown, Variations in the positioning of the crankshaft and the rocking mechanism and the method of altering the position of the linkages, either by hydraulic or mechanical systems, and in addition, the geometry of the linkages to achieve the same outcome, fall within this invention.

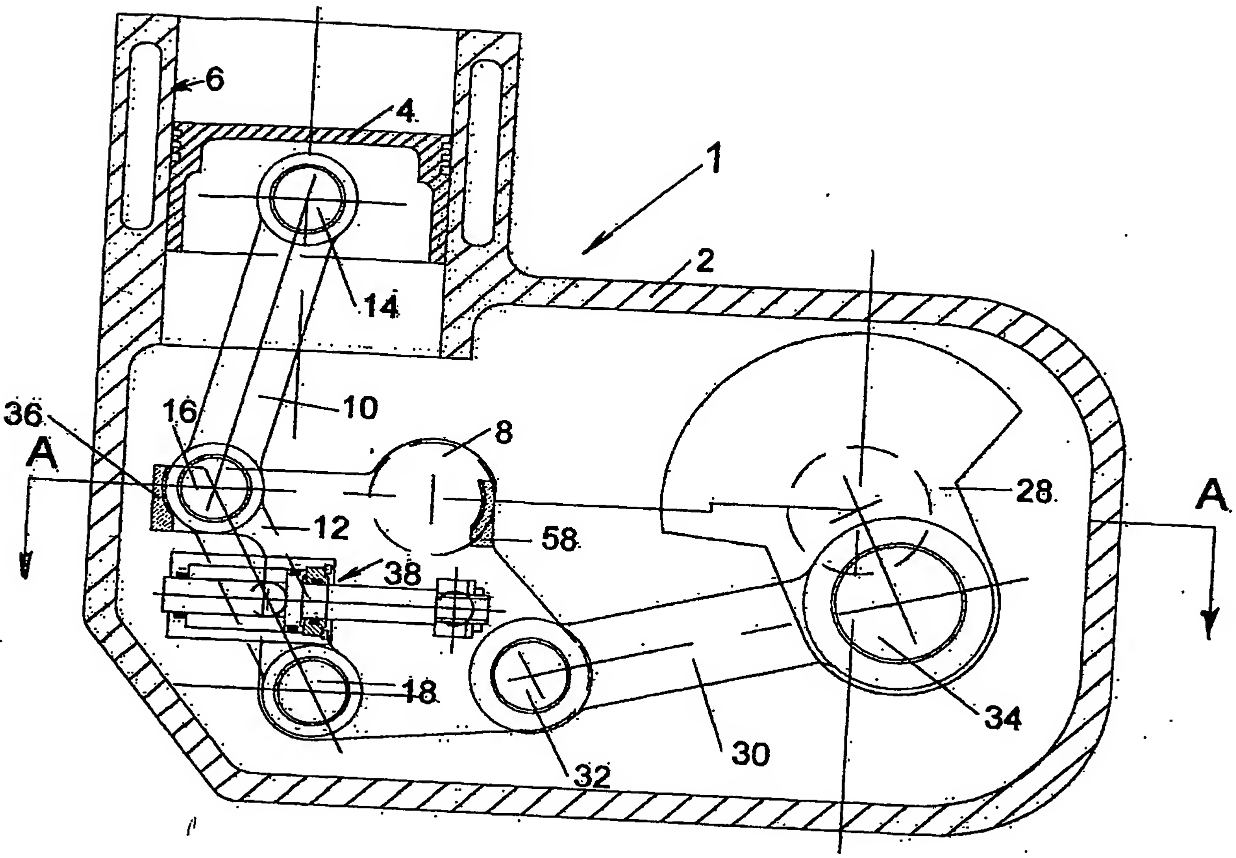


Figure 1

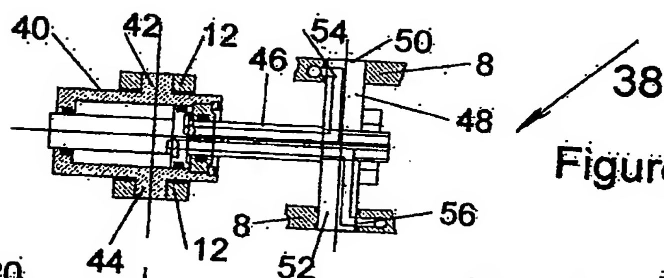
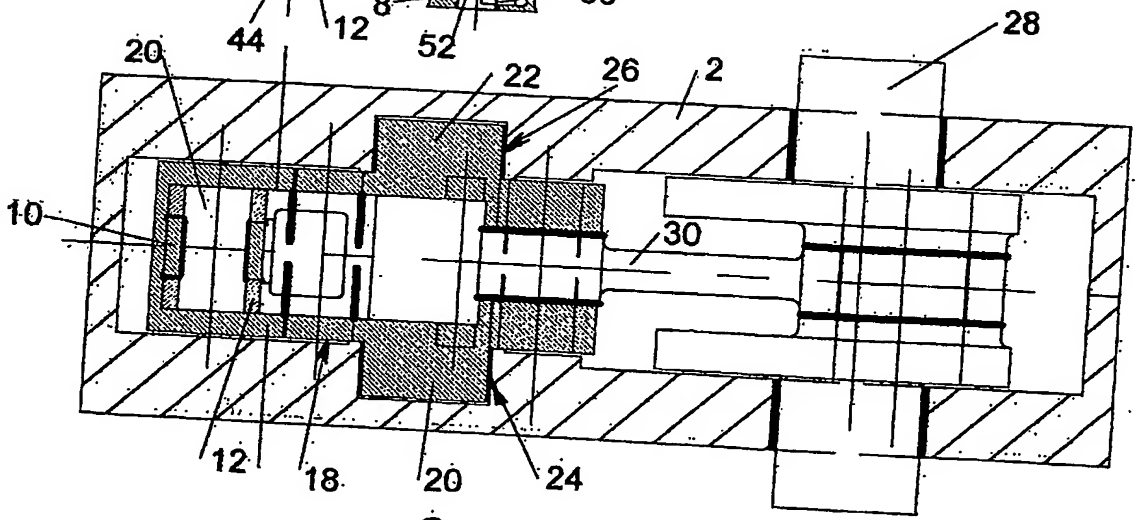


Figure 3



Section A-A

Figure 2

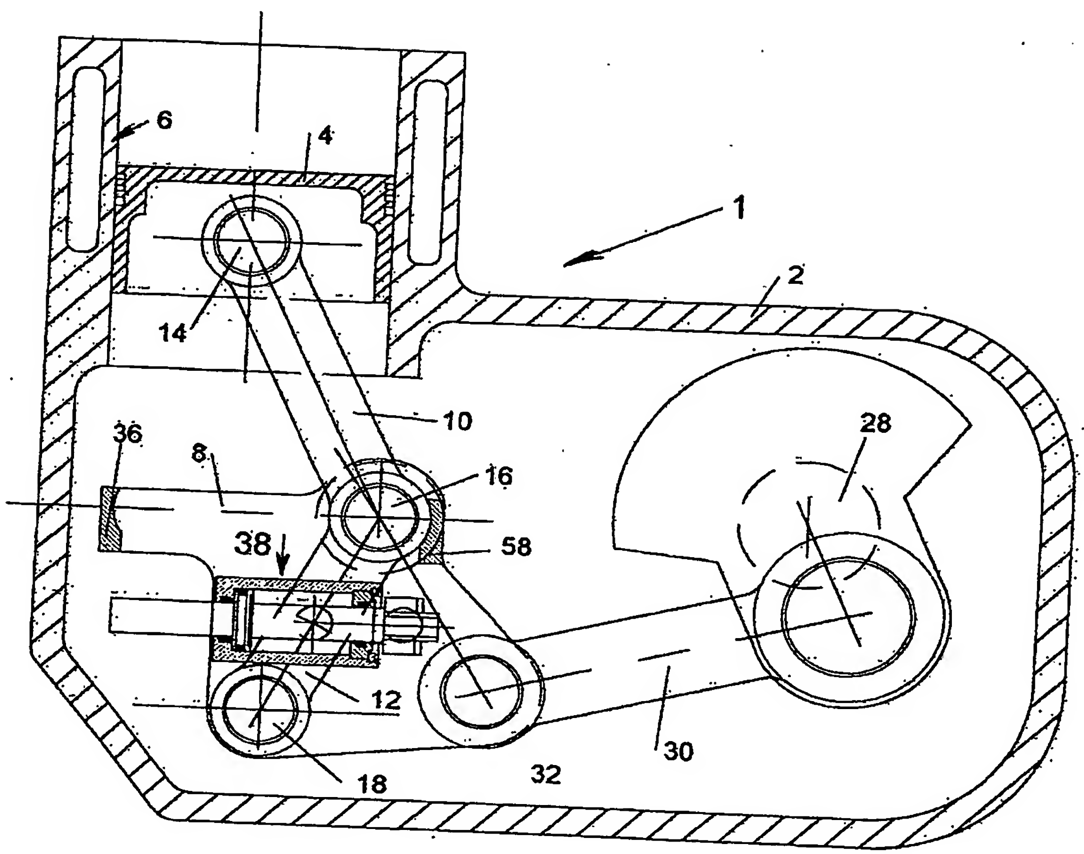


Figure 4